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ABSTRACT

The key student competencies of mathematics education for the School District of Philadelphia, grades seven through twelve, are presented. This book is the second of two that describe the school system's entire mathematics program. The philosophy stated is that mathematics education should prepare students with the mathematics competencies required to function successfully as a citizen, worker, and consumer. Effective living is increasingly dependent on one's proficiency in mathematics. All students can and should learn mathematics from elementary through high school. Descriptions of the key competencies provided in each course offered constitute the bulk of this booklet. Problem solving is a stated major goal in the program and is reflected in the competencies listed. (MP)

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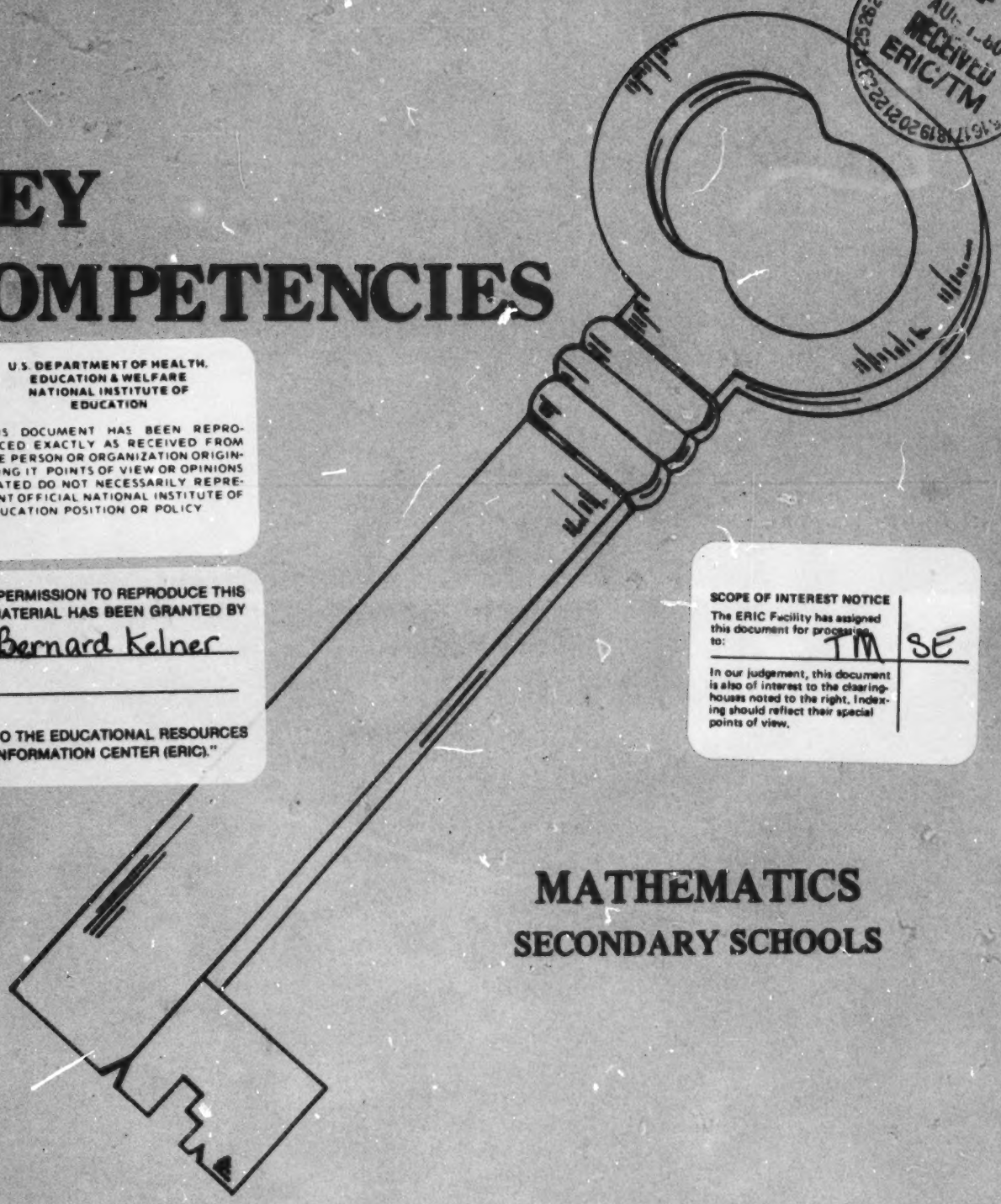
KEY COMPETENCIES



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MATHEMATICS
SECONDARY SCHOOLS

SE 031 774

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Division of Mathematics Education

Key Competencies

MATHEMATICS EDUCATION
(Junior High)
(J-MATH)

and

MATHEMATICS EDUCATION
(Senior High)
(S-GM)

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File #200

June 2, 1980

Dear Colleagues:

The School District of Philadelphia is committed to quality education for all its students. In this regard, two recent events are of particular significance: the Board of Education resolution reaffirming the use of mandated curricula and the Superintendent's "Blueprint for Academic Achievement." All schools, unless receiving official approval to do otherwise, are to use the School District's courses of study; all students are to be considered as having high potential.

The "Blueprint" calls for the identification of essential learning for each grade. To assist principals and teachers, the Office of Curriculum and Instruction has prepared "Key Competencies" for the mandated subjects. With each competency are behavioral objectives which can be used to evaluate mastery of the competency. The lists are comprehensive and coded for easy reference. Each publication contains the sequence of competencies for either elementary or secondary subjects thus providing a perspective of learning over a period of time. Copies are being distributed to all personnel directly involved with instruction.

It should be noted that the term *key competency* signifies the opening of the door to learning. In no way should mastery of these competencies be considered the limit of education. The courses of study provide a full array of content and activities. On the other hand, failure to master the key competencies should be a signal for intensive evaluation of the effectiveness of the educational program - a process calling for collaborative effort of school, home, and if need be, community.

A curriculum publication is, by its very nature, always in a state of development. Your review of this document is eagerly sought and your recommendations will be deeply appreciated. Please send your comments to me. I am as close to you as your phone.

With every good wish.

BERNARD G. KELNER
Associate Superintendent
Curriculum and Instruction

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MATHEMATICS EDUCATION

The mathematics education program prepares students with the mathematics competencies required to function successfully as a citizen, worker, and consumer. Effective living is increasingly more dependent on one's being proficient in mathematics.

Problem-solving is a major goal in the program. The mathematics program takes full advantage of the power of the calculator and computer at all grade levels.

The competencies are derived from a flexible curriculum with a wide range of options designed to accommodate the diverse needs of students in an urban environment.

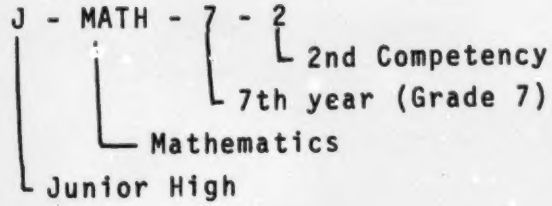
The philosophy of the mathematics program is predicated on the assumption that all students can and should learn mathematics from elementary through high school.

The scope of the mathematics education program is for grades one through twelve.

The booklet will treat key competencies in the secondary program (grades seven through twelve).

The following coding system was used to designate the competencies:

Example A:



01 - Student Outcome 1
02 - Student Outcome 2
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Example B:

S - GM - 1 - 3
- 3rd Competency
- 1st Course
- General Mathematics
- Senior High

01 - Student Outcome 1
02 - Student Outcome 2

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Note: The following courses are given in the secondary program:

J - MATH - 7	-	Mathematics (7th year)
J - MATH - 8	-	Mathematics (8th year)
S - GM - 1	-	General Mathematics (Usually 9th year)
S - GM - 2	-	General Mathematics (Usually 10th year)
S - Alg - 1	-	Algebra (Usually 9th year)
S - Alg - 2	-	Algebra (10th year or 11th year)
S - Geom - 1	-	Geometry (9th year or 10th year)
S - ELFN - 1	-	Elementary Functions (11th year or 12th year)

For further information regarding mathematics education, its curriculum and services, please refer to Curriculum Means Services or contact:

Dr. Alexander Tobin, Director
Division of Mathematics Education
Administration Building
Parkway at 21st Street - Rm. 310
Philadelphia, PA 19103

Phone: 299-7813

SECONDARY MATHEMATICS
(J-MATH-7)

Key Competencies

Grade 7
Levels 16, 17 and 18

J-MATH-7-1 STUDENTS WILL DEMONSTRATE SKILL WITH SYSTEMS OF NUMERATION:

01. Read and write numbers greater than 1,000,000.

02. Read and write Roman numerals to MM.

03. Compute powers of numbers (exponents).

J-MATH-7-2 STUDENTS WILL DEMONSTRATE COMPUTATIONAL SKILLS WITH WHOLE NUMBERS:

01. Divide using a 3-place divisor.

02. Add and subtract positive and negative integers using the number line and missing addend approach.

J-MATH-7-3 STUDENTS WILL DEMONSTRATE SKILL IN THE USE OF FRACTIONAL NUMBERS:

01. Use cross products of common fractions to determine equivalence and order relations.

02. Add and subtract using 3 addends; multiplying with 3 factors.

03. Use and rename common fractions and ratios as percent.

04. Read, write, add, subtract, multiply, and divide decimals to thousandths and beyond.

05. Write and work with equivalent ratios (proportion).

Grade 7
Levels 16, 17 and 18

J-MATH-7-3 STUDENTS WILL DEMONSTRATE SKILL IN THE USE OF FRACTIONAL NUMBERS (continued):

06. Develop and construct equations, graphs and diagrams using percent.

07. Find the reciprocal of a number.

08. Divide fractions with like and unlike denominators.

09. Identify repeating decimals.

10. Use ratios in measures.

J-MATH-7-4 STUDENTS WILL DEMONSTRATE SKILL WITH MEASUREMENT TECHNIQUES:

01. Identify and locate the world time zones and international date line.

02. Tell time using the 24-hour clock.

03. Read thermometers to fractions of a degree.

04. Determine volume of solid regions (cubes and rectangular prisms).

05. Use square rod, acre, square mile.

06. Use cubic inch, cubic foot, and cubic yard.

J-MATH-7-5 STUDENTS WILL DEMONSTRATE SKILL IN ORGANIZING AND INTERPRETING DATA:

01. Use multi-bar and divided-bar graphs.

02. Graph ordered pairs on both X and Y axes in four quadrants.

03. Make frequency distributions and histograms.

Grade 7
Level 16, 17 and 18

J-MATH-7-5

STUDENTS WILL DEMONSTRATE SKILL IN ORGANIZING AND INTERPRETING DATA:

04. Construct a perpendicular to a line from a point on the line and from a point not on the line.

05. Determine the sum of the measures of the angles of triangles and other geometric figures.

06. Construct equilateral and isosceles triangles and triangles with lengths of sides given.

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SECONDARY MATHEMATICS
(J-MATH-8)

Key Competencies

Grade 8
Levels 19, 20 and 21

J-MATH-8-1 STUDENTS WILL IDENTIFY NUMBERS OF DIFFERENT PARITY:

01. Recognize an odd number.

02. Recognize an even number.

J-MATH-8-2 STUDENTS WILL OPERATE WITH NUMBERS OF DIFFERENT PARITY:

01. Add, subtract, multiply and divide odd numbers.

02. Add, subtract, multiply and divide even numbers.

J-MATH-8-3 STUDENTS WILL RECOGNIZE SEQUENCE OF FIGURATE NUMBERS:

01. Extend sequences of rectangular, square, and triangular numbers.

J-MATH-8-4 STUDENTS WILL OPERATE WITH NUMBERS IN EXPONENTIAL FORM:

01. Multiply numbers in exponential form.

02. Divide numbers in exponential form.

J-MATH-8-5 STUDENTS WILL CONVERT NUMBERS TO SCIENTIFIC NOTATION:

01. Write very large numbers in scientific notation.

02. Write very small numbers in scientific notation.

Grade 8
Levels 19, 20 and 21

J-MATH-8-6 STUDENTS WILL BECOME FAMILIAR WITH PRIME NUMBERS:

01. Identify primes less than 100.

02. Identify twin primes.

03. Determine when two numbers are relatively prime.

J-MATH-8-7 STUDENTS WILL USE COMMON DIVISIBILITY TESTS:

01. Test for divisibility by 2, 5, or 10.

02. Test for divisibility by 3, 6, or 9.

03. Test for divisibility by 7, 4, 8.

J-MATH-8-8 STUDENTS WILL SHOW KNOWLEDGE OF POSITIVE AND NEGATIVE INTEGERS.

01. Determine the absolute value of an integer.

02. Add, subtract, multiply and divide positive and negative integers.

03. Use proper order of operations.

J-MATH-8-9 STUDENTS WILL SOLVE OPEN-NUMBER SENTENCES:

01. Find a unique solution.

02. Determine where there are infinite solutions.

03. Determine if there is no solution.

04. Solve sentences with more than one variable.

05. Solve sentences which have two solutions.

06. Solve inequalities by using equivalent sentences.

Grade 8
Levels 19, 20 and 21

J-MATH-8-9 STUDENTS WILL SOLVE OPEN-NUMBER SENTENCES (continued):

07. Solve inequalities which involve multiplication or division by a negative number.

08. Solve inequalities with two variables.

J-MATH-8-10 STUDENTS WILL WORK WITH RATIONAL NUMBERS:

01. Define rational number.

02. Use correct notation.

03. Form equivalence classes.

04. Operate with rational numbers.

05. Show knowledge of the properties of the rational numbers.

J-MATH-8-11 STUDENTS WILL MAKE RATIOS:

01. Compare areas of squares.

02. Compare areas of rectangles.

J-MATH-8-12 STUDENTS WILL WORK WITH REAL NUMBERS:

01. Define an irrational number.

02. Define a real number.

03. Use notation for square root.

04. Find a square root by zeroing in or using a table.

05. Know the structure of the real numbers.

Grade 8
Levels 19, 20 and 21

J-MATH-8-13 STUDENTS WILL COMPUTE SQUARE MEASURE:

01. Find the area of a parallelogram.

02. Find the arc of a triangle.

03. Find the area of a trapezoid.

J-MATH-8-14 STUDENTS WILL COMPUTE SURFACE AREA AND VOLUME:

01. Determine surface area and volume for:

a. Cubes
b. Square base pyramids
c. Rectangular pyramids and prisms
d. Equilateral triangle base pyramids and prisms
e. Right circular cylinders and cones
f. Spheres

J-MATH-8-15 STUDENTS WILL COMPUTE SIMPLE PROBABILITIES:

01. Find probability with two possible outcomes.

02. Find probability with equally likely outcomes.

03. Use the success formula.

04. Find probability with unequally likely outcomes.

05. Recognize impossible and certain events.

J-MATH-8-16 STUDENTS WILL DIAGRAM PROBABILITIES:

01. Determine a simple space.

02. Draw a tree diagram.

J-MATH-8-17 STUDENTS WILL COMPUTE MEASURES OF CENTRAL TENDENCY:

01. Determine frequencies.

Grade 8
Levels 19, 20 and 21

J-MATH-8-17 STUDENTS WILL COMPUTE MEASURES OF CENTRAL TENDENCY (continued):

02. Compute mean, median, mode and range of data.

03. Construct a histogram.

J-MATH-8-18 STUDENTS WILL GRAPH SOLUTIONS OF OPEN SENTENCES:

01. Graph 1-point solutions.

02. Graph 2-point solutions.

03. Graph infinite point solutions.

04. Graph solutions of inequalities.

05. Graph solutions of open sentences with two variables.

06. Graph solutions of sentences with rational solutions.

J-MATH-8-19 STUDENTS WILL READ FLOW CHARTS:

01. Recognize symbols used.

02. Follow instructions.

03. Construct loops.

04. Design flow charts.

05. Read flow charts in computer language.

J-MATH-8-20 STUDENTS WILL DETERMINE TYPES OF SYMMETRY:

01. Recognize line symmetry.

02. Recognize point symmetry.

Grade 8
Levels 19, 20 and 21

J-MATH-8-21 STUDENTS WILL DETERMINE CONGRUENCE BETWEEN FIGURES:

01. Use a translation.

02. Use a reflection.

03. Use a rotation.

J-MATH-8-22 STUDENTS WILL DETERMINE CONGRUENCY OF TRIANGLES:

01. Use the side-side-side relationship.

02. Use the side-angle-side relationship.

03. Use the angle-side-angle relationship.

J-MATH-8-23 STUDENTS WILL DETERMINE SIMILARITY OF FIGURES:

01. Find similarity of polygons

02. Find similarity of triangles.

J-MATH-8-24 STUDENTS WILL RECOGNIZE SPECIAL PROPERTIES OF THE RIGHT TRIANGLE:

01. Use relationships in the 30^0-60^0-90^0 triangle.

02. Use relationships in the 45^0-45^0-90^0 triangle.

03. Use the Pythagorean relationship.

J-MATH-8-25 STUDENTS WILL USE THE NOTATION OF SETS:

01. Use brace notation.

02. Use roster notation.

03. Use rule notation.

04. Use symbol notation.

Grade 8

LEVELS 19, 20 and 21

J-MATH-8-26 STUDENTS WILL DETERMINE THE MEASURES OF A SET:

01. Determine cardinality.

J-MATH 8-27 STUDENTS WILL PERFORM OPERATIONS ON SETS:

01. Determine a complement.
02. Determine a union.
03. Determine an intersection.

J-MATH-8-28 STUDENTS WILL DIAGRAM SETS:

01. Construct a Venn diagram.
02. Show universal set relationship.
03. Show subset relationship.

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GENERAL MATHEMATICS
(S-GM-1)

Key Competencies

S-GM-1-1 STUDENTS WILL DEMONSTRATE AN UNDERSTANDING OF THE FUNDAMENTAL OPERATIONS OF ARITHMETIC AND ACQUIRE ACCURACY IN ARITHMETIC COMPUTATION:

01. Count quantities.

02. Read and write
    a. Whole numbers
    b. Fractions
    c. Decimals

03. Order and compare
    a. Whole numbers
    b. Fractions
    c. Decimals

04. Determine equivalent forms of fractions, decimals and percents.
    a. Change fractions to decimals and vice versa.
    b. Change decimals to percents and vice versa.
    c. Change fractions to percents and vice versa.

05. Compute and solve open sentences
    a. Add whole numbers, fractions and decimals.
    b. Subtract whole numbers, fractions and decimals.
    c. Multiply whole numbers, fractions and decimals.
    d. Divide whole numbers, fractions and decimals.
    e. Find percents of numbers.
    f. Find averages.
    g. Solve proportions.

06. Demonstrate an understanding of integers
    a. Show an awareness of the need of integers.
    b. Show an understanding of the opposite of an integer.
    c. Operate with integers.
    d. Graph equations involving integers.

S-GM-1-2 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF AND SKILLS NECESSARY FOR MAKING INTELLIGENT DECISIONS INVOLVING FINANCIAL MATTERS OF THE WORLD OF WORK:

01. Compute earnings
    a. On a time basis - hourly, daily, weekly, monthly, yearly
    b. Overtime
    c. Individual initiatives - piece work, commissions, gratuities, bonuses, travel expenses, "fringe benefits"
    d. "Take home" pay - deductions, withholding tax, F.I.C.A., city and/or local wage taxes, other deductions.

02. Handle money and accounts
    a. Make change
    b. Package coins
    c. Total sales

03. Use forms in handling accounts - driver-salesperson, collector-salesperson, billing clerks, etc.

S-GM-1-3 STUDENTS WILL DEMONSTRATE SKILL IN THE MATHEMATICS APPLICATIONS CONFRONTING WORKERS:

01. Use linear measure
    a. Determine appropriate units of measure - customary and metric
    b. Use a ruler
    c. Change units
        1. within customary system
        2. within metric system

02. Use formulas in linear measure - perimeter and circumference.

03. Solve problems involving linear measure.

04. Use square measure.

05. Use formulas in square measure - area.

06. Solve problems involving square measure.

07. Use cubic measure.

S-GM-1-3 STUDENTS WILL DEMONSTRATE SKILL IN THE MATHEMATICS APPLICATIONS CONFRONTING WORKERS (continued):

08. Use formulas in cubic measure - volume.

09. Solve problems involving cubic measure.

10. Use measuring devices and tables
    a. Protractor
    b. Ruler
    c. To read and interpret meters and gauges, weight scales
    d. To read and interpret tables of measure, schedules, interest, rate, etc.

11. Use indirect measurement and construction
    a. Estimate and approximate
    b. Construct geometric figures using straightedge, protractor and compass
    c. Use scale drawings
    d. Find square root

12. Use the Pythagorean Theorem

13. Use the concepts of similarity and congruence of triangles to solve problems

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ALGEBRA I
(S-ALG-1)

Key Competencies

S-ALG-1-1 STUDENTS WILL ARTICULATE THE VOCABULARY AND LANGUAGE OF NUMERICAL ALGEBRA:

01. Identify and describe the types of real numbers and their primary use, i.e., natural number, integer, rational number.

02. Identify and describe algebraic terms, i.e., variable, coefficient, exponent, rational algebraic expression, polynomial, linear equation, function, quadratic, quadratic equation.

03. Identify and describe algebraic processes and relationships, i.e., equality, inequality, factor of, sum of, difference of, product of, power of, quotient of, square root of, distribution of, inverse of (opposite and reciprocal).

04. Identify and describe Cartesian coordinates and their graphs.

S-ALG-1-2 STUDENTS WILL DEMONSTRATE AN UNDERSTANDING OF NATURAL NUMBERS:

01. Perform basic arithmetic operations with natural numbers, i.e., addition, subtraction, multiplication, division.

02. Determine the size ordering of any collection of natural numbers and graph such on a number line.

03. Perform the 'power of' with natural numbers as a base and exponent, and read table containing the square and square root of natural numbers.

S-ALG-1-3 STUDENTS WILL DEMONSTRATE AN UNDERSTANDING OF INTEGERS:

01. Determine the size ordering of any collection of integers by use of a number line and/or specific rules.

S-ALG-1-3 STUDENTS WILL DEMONSTRATE AN UNDERSTANDING OF INTEGERS (continued):

02. Write and perform algebraic operations by their given order or a specific order.
    a. Sum, difference, product, quotient
    b. Calculation involving more than one operation and brackets
    c. 'Power of' with the base or exponent as an integer.

03. Write, read and solve simple equations involving only integers.

04. Apply integers to measuring situations or formulae where quantity and quality are important.

S-ALG-1-4 STUDENTS WILL DEMONSTRATE AN UNDERSTANDING OF RATIONAL NUMBER IN FRACTIONAL AND DECIMAL FORM:

01. Determine the size ordering of any collection of rational numbers.

02. Write and perform numerical-algebraic operations according to well-defined sequences.
    a. Translate between fractional and decimal form.
    b. Sum, difference, product, quotient
    c. Calculations involving more than one operation and brackets.
    d. 'Power of', where only the base is a rational number and the exponent is any integer. Square root of positive rational numbers.

03. Write, read and solve equations which involve rational numbers.

04. Apply rational numbers to counting and measuring situations or formulae where comparison is essential, i.e. proportions.

S-ALG-1-5 STUDENTS WILL DEMONSTRATE AN UNDERSTANDING OF ALGEBRAIC EXPRESSIONS AND ALGEBRAIC STATEMENTS:

01. Write and read symbolic forms which indicate real number algebraic sum, product, quotient, difference, power, and square root.

S-ALG-1-5 STUDENTS WILL DEMONSTRATE AN UNDERSTANDING OF ALGEBRAIC EXPRESSIONS AND ALGEBRAIC STATEMENTS (continued):

02. Write and perform real number algebraic simplification and evaluation governed by rules of sequential order of operations or a specific order, i.e. factoring and distribution.
   a. Polynomials (monomial, binomials, quadratics)
   b. Rational algebraic expressions
   c. Exponentials
   d. Synthetic division

03. Write and solve equations or inequalities.
   a. Proportions
   b. Linear equations/inequalities
   c. Quadratics - use of factorization and/or quadratic formulae

04. Apply real number algebraic principles to problem situations which have data and/or conditions which are of dimension ≤ 2.
   a. Generalizations of combining rules
   b. Generalization of special countings, measurings,
   c. Verbal problems addressing perimeter, area, percentage, variation, average, motion, number patterns, etc.

S-ALG-1-6 STUDENTS WILL DEMONSTRATE AN UNDERSTANDING OF THE USE OF REFERENCE TABLES, GRAPHS, AND GRAPHING:

01. Construct, read, and interpret data for and from bar graphs, circle graphs, line graphs, reference tables.

02. Construct, read, and interpret a number line and graphing principles of inequalities.

03. Construct, read and interpret Cartesian coordinate system.
   a. Label origin, axes, and quadrants.
   b. Translate between ordered pairs and point locations
   c. Graph any function or relation of two variables after indicating the domain and range.
   d. Translate between any linear function form, its slope, its intercepts, any solution pairs, and its graph.

04. Apply the principles of linear systems to situations of the social sciences, management, and/or marketing.

GENERAL MATHEMATICS
(S-GM-2)

Key Competencies

S-GM-2-1 STUDENTS WILL USE A CHECKING ACCOUNT:

01. Write a check.
02. Add and subtract money.
03. Complete a check stub.
04. Make a deposit.
05. Write checks in series.
06. Read a checking account statement.
07. Reconcile a checking account.

S-GM-2-2 STUDENTS WILL COMPUTE LINEAR MEASURE:

01. Determine various parts of an inch.
02. Add fractions.
03. Compute perimeter.

S-GM-2-3 STUDENTS WILL COMPUTE SQUARE MEASURE:

01. Find area by counting squares.
02. Find area of a rectangular region using a formula.

S-GM-2-4 STUDENTS WILL COMPUTE VALUES USING FORMULAE:

01. Compute pay and selling price.
02. Compute simple interest.

S-GM-2-5 STUDENTS WILL SOLVE EQUATIONS USING INVERSE OPERATIONS:

01. Undo addition and subtraction.
02. Undo multiplication and division.

S-GM-2-6 STUDENTS WILL WRITE FORMULAE:

01. Translate from verbal description to formula.

S-GM-2-7 STUDENTS WILL USE FORMULAE TO SOLVE PROBLEMS:

01. Select and evaluate formulae to solve problems.

S-GM-2-8 STUDENTS WILL DO PROBLEMS ASSOCIATED WITH SUPERMARKET SHOPPING:

01. Make a shopping list.

02. Price a shopping list.

03. Use discount coupons.

04. Compute unit price.

05. Compute change.

S-GM-2-9 STUDENTS WILL COMPUTE PER CENT FOR DISCOUNT:

01. Compute a sale discount.

02. Check accuracy of advertisements.

03. Compute discount for cash.

S-GM-2-10 STUDENTS WILL USE THE COMMON METRIC MEASURING UNITS:

01. Measure in millimeters, centimeters, decimeters.

02. Change linear units.
    a. Large to small
    b. Small to large

03. Use units of mass
    a. Milligram
    b. Gram
    c. Kilogram

04. Use units of liquid measure
    a. Milliliter
    b. Liter
    c. Kiloliter

S-GM-2-11 STUDENTS WILL CREATE AND USE A BUDGET:

01. Create a budget for a worker.

02. Budget rent.

03. Buy a car.

04. Borrow and budget money.

S-GM-2-12 STUDENTS WILL COMPUTE SALARY AND DEDUCTIONS FOR A JOB:

01. Use time cards.

02. Compute gross pay.

03. Compute overtime pay.

04. Compute tax deductions.

05. Compute net pay.

S-GM-2-13 STUDENTS WILL COMPUTE MEASURES OF CENTRAL TENDENCY:

01. Compute mean.

02. Construct a frequency table.

03. Determine mode.

04. Compute median

S-GM-2-14 STUDENTS WILL COMPUTE SIMPLE PROBABILITIES:

01. Compute probabilities of coin tosses.

02. Compute probabilities of dice rolls.

03. Compute probabilities using other experiments.

S-GM-2-15 STUDENTS WILL COMPUTE VALUES ASSOCIATED WITH SELLING:

01. Complete a sales slip.

02. Compute sales tax.

03. Compute commission.

04. Make change.

S-GM-2-15 STUDENTS WILL COMPUTE VALUES ASSOCIATED WITH SELLING (continued):

05. Complete cash receipt.

06. Compute real estate commission.

07. Compute cost of mortgage.

08. Compute real estate taxes.

ALGEBRA 2
(S-ALG-2)

Key Competencies

S-ALG-2-1 STUDENTS WILL EXHIBIT AN UNDERSTANDING OF THE PROPERTIES OF REAL NUMBERS:

01. Identify the order relation between any two real numbers (axiom of comparison).

02. Identify the order relation between any three real numbers (transitivity).

03. Graph solutions sets for order relations.

04. Identify examples of group properties for addition and multiplication of real numbers.

05. Identify the axioms of equality.

S-ALG-2-2 STUDENTS WILL EXHIBIT AN UNDERSTANDING OF THE APPLICATIONS TO ARITHMETIC OF REAL NUMBERS:

01. Perform operations with absolute value.

02. Perform operations with directed (signed) numbers.

S-ALG-2-3 STUDENTS WILL EXHIBIT AN UNDERSTANDING OF OPEN SENTENCES IN ONE VARIABLE:

01. Find solution sets for equivalent equations and inequalities.

02. Graph solutions sets of open sentences.

03. Translate word problems into algebraic expressions or open sentences.

S-ALG-2-4 STUDENTS WILL EXHIBIT AN UNDERSTANDING OF OPEN SENTENCES IN TWO VARIABLES:

01. Construct a Cartesian coordinate system.

02. Graph linear functions.

03. Find the slope, y-intercept or/and equation of a line.

S-ALG-2-5 STUDENTS WILL EXHIBIT AN UNDERSTANDING OF SYSTEMS OF LINEAR SENTENCES:

01. Graph and describe parallel, intersecting and coinciding lines.

02. Solve systems of linear equations.

03. Graph linear inequalities.

S-ALG-2-6 STUDENTS WILL EXHIBIT AN UNDERSTANDING OF FUNCTIONS AND RELATIONS:

01. Define relations and functions in terms of their ranges and domains.

02. Identify graphs of functions or relations.

03. Solve problems involving direct and inverse variations.

S-ALG-2-7 STUDENTS WILL EXHIBIT AN UNDERSTANDING OF POLYNOMIAL FUNCTIONS:

01 Find the greatest common factor and the least common multiple of monomials.

02. Write polynomials as the product of polynomials.

03. Identify and find common factors and multiples of polynomials.

04. Solve examples of polynomial functions over the set of real numbers.

05. Divide polynomials.

S-ALG-2-8 STUDENTS WILL EXHIBIT AN UNDERSTANDING OF RATIONAL EXPRESSIONS:

01. Identify and apply the Laws of Exponents to simplify rational expressions.

02. Simplify rational algebraic expressions.

03. Find equilivant expressions of rational algebraic expressions.

S-ALG-2-9 STUDENTS WILL EXHIBIT AN UNDERSTANDING OF OPERATIONS WITH ALGEBRAIC FRACTIONS:

01. Simplify complex fractions.

02. Solve rational equations.

S-ALG-2-10 STUDENTS WILL EXHIBIT AN UNDERSTANDING OF POWER FUNCTIONS AND VARIATIONS:

01. Identify power functions which are examples of direct, inverse and combined variations.

02. Graph power functions.

S-ALG-2-11 STUDENTS WILL EXHIBIT AN UNDERSTANDING OF REAL ROOTS:

01. Find the real root of equations over the set of real numbers.

02. Find and identify roots as rational or irrational.

S-ALG-2-12 STUDENTS WILL EXHIBIT AN UNDERSTANDING OF PROPERTIES OF RADICAL:

01. Simplify expression involving radical performing operations with irrational expressions.

S-ALG-2-13 STUDENTS WILL EXHIBIT AN UNDERSTANDING OF IMAGINARY NUMBERS:

01. Identify the value of the imaginary unit i, as $\sqrt{-1}$ and/or $i^2 = -1$.

02. Identify a complex number a + bi ($a,b \in R$ and $b \neq 0$).

03. Express radicals with negative radicands as complex numbers.

S-ALG-2-14 STUDENTS WILL EXHIBIT AN UNDERSTANDING OF OPERATIONS WITH COMPLEX NUMBERS:

01. Find sums and products of complex numbers.

02. Express the product of conjugates as a non-negative real number.

03. Express quotients in the form a + bi.

S-ALG-2-15 STUDENTS WILL EXHIBIT AN UNDERSTANDING OF SOLVING QUADRATIC EQUATIONS:

01. Complete the square.

02. Use the quadratic formula.

03. Find a quadratic equation, given its roots.

04. Identify the root of a rational or irrational using discriminants.

S-ALG-2-16 STUDENTS WILL EXHIBIT AN UNDERSTANDING OF RADICAL EQUATIONS:

01. Solve equations with one variable in the radicand.

02. Solve equations with more than one variable in the radicand.

S-ALG-2-17 STUDENTS WILL EXHIBIT AN UNDERSTANDING OF GRAPHS OF QUADRATIC FUNCTIONS:

01. Identify the graph of the quadratic equation as a parabola when $a \neq 0$.

02. Identify the location of the axis of symmetry, vertex and extrema.

S-ALG-2-18 STUDENTS WILL EXHIBIT AN UNDERSTANDING OF QUADRATIC RELATIONS:

01. Identify equations and graph solution sets for:

a. Circle
b. Parabola
c. Ellipse
d. Hyperbola

S-ALG-2-19 FIND THE SOLUTION OF A SYSTEM OF EQUATIONS CONSISTING OF LINEAR AND QUADRATIC EQUATIONS:

S-ALG-2-20 STUDENTS WILL EXHIBIT AN UNDERSTANDING OF EXPONENTIAL FUNCTIONS:

01. Write radical expression in exponential form.

02. Evaluate exponential expressions using the Laws of Exponents.

S-ALG-2-21 STUDENTS WILL DEMONSTRATE AN UNDERSTANDING OF LOGARITHMS:

01. Describe the relationship between exponential and logarithmic functions.

02. Find the products and quotients, powers and roots of logarithms.

03. Find common logarithms of integral powers of 10.

04. Use tables of logarithms to find non-integral powers of 10.

05. Perform interpolations with logarithms.

06. Solve logarithmic and exponential equations.

S-ALG-2-22 STUDENTS WILL EXHIBIT AN UNDERSTANDING OF ARITHMETIC SEQUENCES AND SERIES:

01. Find the nth term in an arithmetic sequence.

02. Find the arithmetic mean for a given set of numbers.

03. Find the sum of an arithmetic series using summation notation.

04. Solve practical problems involving arithmetic sequences and series.

S-ALG-2-23 STUDENTS WILL EXHIBIT AN UNDERSTANDING OF GEOMETRIC SEQUENCES AND SERIES:

01. Identify geometric sequences by finding common ratios.

02. Find the geometric mean for a given set of numbers.

03. Find the sum and geometric series for a given set of data.

S-ALG-2-23 STUDENTS WILL EXHIBIT AN UNDERSTANDING OF GEOMETRIC SEQUENCES AND SERIES (continued):

04. Solve practical problems involving geometric sequences and series.

S-ALG-2-24 STUDENTS WILL EXHIBIT AN UNDERSTANDING OF BINOMIAL EXPANSION:

01. Writing binomials in expanded form and simplifying.

02. Find and simplify a term in an expansion.

03. Describe the relationship between the coefficients in the binomial expansion and Pascal's Triangle.

GEOMETRY
(S-GEOM-1)

Key Competencies

S-GEOM-1-1 STUDENTS WILL RECOGNIZE EXAMPLES OF GEOMETRIC TERMS:

01. Identify and/or sketch examples of the following.

a. Basic elements of segment, ray, angle, a coordinate graph, parallel lines with a transversal, vertex.
b. Types of angles, i.e., right, acute, obtuse, straight, interior, exterior, corresponding, alternate.
c. Types of triangles and their parts, i.e., isosceles, equilateral, right, median, altitude, angle bisector.
d. Types of polygons and their parts, i.e., parallelogram, square, rectangle, rhombus, hexagon, diagonal, interior/exterior angle, regular polygons.
e. Types of non-linear figures and their figures: circle, cylinder, sphere, cone, center, radius, diameter, tangent, secant, central angle, arc, sector, inscribed angle, interior angle, exterior angle.

S-GEOM-1-2 STUDENTS WILL DEMONSTRATE EXAMPLES OF GEOMETRIC RELATIONSHIPS:

01. Identify and/or sketch examples of the following: between, interior of, exterior of, intersection, collinear with, coplanar with, bisection of line and angle, concentric width.

02. Distinguish among: parallel to, intersection with, adjacent to, complementary to, supplementary to, perpendicular to, congruent to, similar to.

S-GEOM-1-3 STUDENTS WILL APPLY A NAME OR LABEL:

01 Utilize a distinguishable notation for geometric terms, i.e., point, segment, ray, angle, polygon, circle, arc, sector.

S-GEOM-1-3 STUDENTS WILL APPLY A NAME OR LABEL (continued):

02. Utilize a specialized notation for geometric relationship of; parallel to, perpendicular to, congruent to, similar to.

S-GEOM-1-4 STUDENTS WILL APPLY NUMERICAL-ALGEBRAIC COMPETENCIES TO GEOMETRY:

01. Count the number of edges, faces, vertices, angles; units of measure for distance, area, volume, and angular change.

02. Use a graduated metric and customary ruler, or protractor, to measure and calculate the following:

a. Distance - length, width, height, arc, length, diagonal, perimeter, radius, diameter, chord, tangent, circumference.
b. Area - triangle, square, rectangle, trapezoid, parallelogram, circle, sector.
c. Volume - cube, sphere, cylinder.
d. Solutions to similarity problems employing ratios and proportionality.
e. Angles related to - intersecting and parallel lines, interior/exterior angles of polygons, circ[illegible].

03. Use the Pythagoras theorem to measure and calculate side lengths for right triangles.

04. Use Cartesian coordinates to determine linear distance and slope.

S-GEOM-1-5 STUDENTS WILL KNOW HOW TO USE A STRAIGHTEDGE AND DRAWING COMPASS:

01. Draw or construct the following:

a. A copy of any segment and angle.
b. The bisection of any segment and angle.
c. The perpendicular to and from any segment.
d. A circle.
e. A square.
f. An equilateral triangle.
g. Hexagon.

S-GEOM-1-6 STUDENTS WILL DEMONSTRATE AN UNDERSTANDING OF PROOF:

01. Apply the rules of implication, and axiomatic organization, to show congruence of triangles by SSS, SAS, ASA, AAS.

02. Employ the principles of congruent triangles to deduce properties of polygons.

03. Use the principles of construction to demonstrate congruence.

04. Use the rules of implication, measuring, and calculation to determine parallelism, perpendicularity, supplementary angles, complementary angles, and similarity.

05. Use the Pythagorean theorem to demonstrate perpendicularity, Cartesian distance and the "rightness" of triangles.

06. Apply the principles of counting to demonstrate properties of polygons, angle size and their relationships, and the determination of a geometric solid.

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ELEMENTARY FUNCTIONS
(S-ELFN-1)

Key Competencies

S-ELFN-1-1 STUDENTS WILL DEMONSTRATE AN UNDERSTANDING OF SETS:

01. Write and read set notation, i.e. a member of, subset, set builder notation.

02. Write, read, and perform elementary set operations of: intersection of, complement of, union of, and subset of.

03. Write, read, and perform computations and calculations with the set of real numbers.

S-ELFN-1-2 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF TRIGONOMETRIC CONCEPTS AND PRINCIPLES:

01. Identify and describe the six trigonometric functions with a right triangle and/or unit circle in Cartesian coordinates.

02. Write and prove trigonometric identities by applying the interrelationships among trigonometric functions.

03. Determine, using either calculator or trigonometric reference tables, the value of trigonometric functions with angular measure expressed in degrees, radians, and/or grads.

04. Construct, read, and interpret the rectangular graphs of the six trigonometric functions.

05. Describe the effects on rectangular graphs of the trigonometric functions, multiples of the functions, and multiples of their domain angles.

06. Apply trigonometric concepts and principles to problem situations involving motions or forces (i.e. vectors).

    a. Using the sum and difference of trigonometric functions

S-ELFN-1-2 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF TRIGONOMETRIC CONCEPTS AND PRINCIPLES (continued):

06. b. Using the trigonometric functions of the sum and difference of angular measures.
c. Using the Law of Sines.
d. Using the Law of Cosines.
e. Using the inverse of trigonometric functions.

S-ELFN-1-3 STUDENTS WILL DEMONSTRATE A KNOWLEDGE OF RELATIONS, FUNCTIONS, AND THEIR GRAPHS:

01. Identify and describe the domain, range, and graph of any function or relation.

02. Distinguish between a function and a relation, and classify the function as onto or one-to-one.

03. Write, read, and perform the sum, difference, composition product, quotient, and inverse of appropriate functions.

04. Construct, read, and interpret graphs of linear, polynomial, exponential, logarithmic, and quadratic functions.

S-ELFN-1-4 STUDENTS WILL DEMONSTRATE AN UNDERSTANDING OF LINEAR FUNCTIONS AND THEIR GRAPHS:

01. Translate any linear function, its solution-ordered pairs, its slope, its intercepts, and its Cartesian coordinate graph.

02. Develop and write the equation of any linear function given:
a. Only two solution points
b. Only one solution point and its slope
c. Only its intercepts

03. Develop the relationship between parallel lines and perpendicular lines.

04. Determine the distance measure
a. Between any two points.
b. Between any point and a line.

S-ELFN-1-4 STUDENTS WILL DEMONSTRATE AN UNDERSTANDING OF LINEAR FUNCTIONS AND THEIR GRAPHS (continued):

05. Apply principles of linear functions towards analytical geometric proofs.

S-ELFN-1-5 STUDENTS WILL DEMONSTRATE AN UNDERSTANDING OF QUADRATIC FUNCTIONS AND CONIC SECTIONS:

01. Develop a general equation and graph of the following conic sections from a locus of points description
    a. Circle
    b. Ellipse
    c. Hyperbola

02. Demonstrate the development of these conic sections from one nappe of a cone.

S-ELFN-1-6 STUDENTS WILL DEMONSTRATE A KNOWLEDGE OF EXPONENTIAL AND LOGARITHMIC FUNCTIONS:

01. Calculate using the properties of exponents and logarithms.

02. Translate from exponential form to logarithmic form and develop their graphs.

03. Apply the principles of logarithm to computational problems of growth or change.

04. Read and interpolate logarithmic tables.

S-ELFN-1-7 STUDENTS WILL DEMONSTRATE AN UNDERSTANDING OF THE COMPLEX NUMBERS:

01. Determine the sum, difference, product, quotient and power of complex numbers.

02. Solve quadratic equations having complex numbers as solutions or coefficients.

03. Translate between the graphs of complex numbers in rectangular (Argand) and polar form.

S-ELFN-1-7 STUDENTS WILL DEMONSTRATE AN UNDERSTANDING OF COMPLEX NUMBERS (continued):

04. Apply the principles of complex numbers to geometry.

S-ELFN-1-8 STUDENTS WILL DEMONSTRATE AN UNDERSTANDING OF SEQUENCES AND SERIES:

01. Identify and describe an arithmetic or geometric sequence and find a general equation for its n^{th} term.

02. Determine the summation of the first n^{th} terms of either an arithmetic or geometric series.

03. Estimate the limit of any infinite sequence.

04. Represent series using sigma notation.

S-ELFN-1-9 STUDENTS WILL DEMONSTRATE A KNOWLEDGE OF PROBABILITY:

01. 'Count' using the principles of permutations and combinations.

02. Apply permutational and combinational counting to probability and the binomial theorem.